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JAPAN PATENT OFFICE

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Applicant(s):	STARTING INDUSTRIAL CO., LTD.

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[Title of Document] Specification 1

[Title of Document] Drawings 1

[Title of Document] Abstract 1

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[Proof Required] Yes

[Title of Document] Specification

[Title of the Invention] RECOIL STARTER

[Claims]

[Claim 1] A recoil starter comprising:

a rope reel rotatably mounted to a support shaft formed on an inside of a casing and having a recoil rope wound therearound;

a spiral spring for rotationally urging said rope reel in a direction of winding said recoil rope;

a cam rotatably mounted to said support shaft;

a rotational member attached to a crankshaft of an engine and provided with a one-way clutch mechanism which disengageably engages with said cam;

bosses having the same outer diameter which are formed on said rope reel and said cam, respectively, and which are disposed to butt each other; and

a damper spring in the form of a coil spring disposed around outer peripheries of said bosses and having opposite ends held respectively on said rope reel and said cam, wherein a rotational force of said rope reel is transmitted to said cam via a resilience of said damper spring, characterized in that:

said opposite ends of said damper spring are provided with respective engaging portions which are radially movably supported by holding portions on said rope reel and said cam, respectively, so that when said damper spring is resiliently deformed by a startup resistance of the engine, substantially the overall length of a coiled portion of said damper spring winds and tightens uniformly around the outer peripheral surfaces of both of said bosses formed on said rope reel and said cam, respectively.

[Claim 2] The recoil starter according to claim 1, characterized in that said bosses are extended from and integrally formed on said rope reel and said cam, respectively, and include respective end faces which are butted against each other substantially at the middle of said coiled portion of said

damper spring.

[Claim 3] The recoil starter according to claim 1 or 2, characterized in that said cam is rotatably supported at two locations, one of the locations being a center support portion defined by an end face of said support shaft and the other being an outer peripheral support portion defined by an outer peripheral surface of a flange portion which is radially outwardly protruded and formed on said cam so as to engage with the side surface of said rope reel.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to a recoil starter, wherein a recoil rope is pulled to rotate a rope reel so that a rotation of the rope reel is transmitted to a rotational member coupled to an engine via a one-way clutch mechanism such as a ratchet mechanism, and the engine is started by a rotation of the rotational member.

[0002]

[Prior Art]

Among recoil starters designed to transmit a rotation of a rope reel, rotated by pulling a recoil rope, to a cam and further rotate a rotational member such as a flywheel magnet or a drive pulley via a one-way clutch mechanism such as a centrifugal ratchet mechanism which engages with or disengages from the cam, a recoil starter is known which is constructed to absorb a shock, caused due to fluctuations in load during engine startup and transmitted to an operator's hand, by resiliently coupling the rope reel and the cam through a damper spring in the form of a coil spring to transmit a rotation of the rope reel to the cam via the damper spring.

[0003]

In a conventional recoil starter, as shown in Fig. 6, a damper spring 34 is received within annular recesses 32 and 33

which are formed on opposing surfaces of a rope reel 30 and a cam 31 while one end portion 35 thereof bent in U shape is fitted within a holding groove 36 formed on the rope reel 30 and the other end portion 37 thereof, bent in an axial direction, is inserted into an opening 38 formed in the cam 31. When a rope 39 wound around the rope reel 30 is pulled to rotate the rope reel 30, the cam 31 is rotated via the damper spring 34. When the rotation of the cam 31 is precluded by a startup resistance of the engine, the damper spring 34 is twisted, so that a shock on the rope reel 30 is cushioned and a rotational force of the rope reel 30 is stored in the damper spring 34. When a driving force of the rope reel 30 exceeds the startup resistance of the engine, the rotational force stored in the damper spring 34 is released, so that the cam 31 is rotated to start the engine.

[0004]

In the conventional recoil starter described above, the opposite end portions of the damper spring 34 are held on the rope reel 30 and the cam 31 in a fixed manner, respectively. Thus, these end portions of the damper spring 34 cannot radially move. Therefore, although a middle part of a coiled portion of the damper spring 34 winds and tightens around the outer peripheral surfaces of bosses 40 and 41 of the rope reel 30 and the cam 31, opposite ends of the coiled portion are deformed to the extent that the ends are detached from the outer peripheral surfaces of the bosses 40 and 41 as shown in Fig. 7. Under such a condition, the bent portions at the opposite ends of the damper spring 34 undergo an excessive stress, possibly resulting in breakage of the damper spring 34.

[0005]

A technique has been proposed which restricts the relative rotational angle between the rope reel 30 and the cam 31 by stopper means arranged between the rope reel 30 and the cam 31 to keep load on the damper spring 34 below a predetermined setting. In this technique, however, when the stopper means operates, a

feel of collision is caused and transmitted as a shock to the operator's hand pulling the recoil rope 39, resulting in an unpleasant feel during startup. Further, since the cam 31 is simply supported at its central portion by a support shaft 43 formed on a casing 42 so as to be rotatable, when a spring force of the damper spring 34 acts on the cam 31 while only one of the ratchets 45 is engaged with the cam pawl 44, an eccentric load or a strong leaning force acts on the cam 31, possibly resulting in breakage of the cam 31.

[0006]

The present invention has been made in order to solve the problems associated with the prior art described above. It is therefore an object of the present invention to provide a recoil starter having enhanced durability by improving durability of a damper spring and a cam incorporated therein through inhibiting excessive deformation of the damper spring and an eccentric load on the cam.

[0007]

[Means for Solving Problem]

In accordance with the present invention, a recoil starter comprising: a rope reel rotatably mounted to a support shaft formed on an inside of a casing and having a recoil rope wound therearound; a spiral spring for rotationally urging the rope reel in a direction of winding the recoil rope; a cam rotatably mounted to the support shaft; a rotational member attached to a crankshaft of an engine and provided with a one-way clutch mechanism which disengageably engages with the cam; bosses having the same outer diameter which are formed on the rope reel and the cam, respectively, and which are disposed to butt each other; and a damper spring in the form of a coil spring disposed around outer peripheries of the bosses and having opposite ends held respectively on the rope reel and the cam, wherein a rotational force of the rope reel is transmitted to the cam via a resilience of the damper spring, is characterized in that: the opposite ends

of the damper spring are provided with respective engaging portions which are radially movably supported by holding portions on the rope reel and the cam, respectively, so that when the damper spring is resiliently deformed by a startup resistance of the engine, substantially the overall length of a coiled portion of the damper spring winds and tightens uniformly around the outer peripheral surfaces of both of the bosses formed on the rope reel and the cam, respectively.

[0008]

In accordance with claim 2 of the present invention, the recoil starter is characterized in that the bosses are extended from and integrally formed on the rope reel and the cam, respectively, and include respective end faces which are butted against each other substantially at the middle of the coiled portion of the damper spring.

[0009]

In accordance with claim 3 of the present invention, the recoil starter is characterized in that the cam is rotatably supported at two locations, one of the locations being a center support portion defined by an end face of the support shaft and the other being an outer peripheral support portion defined by an outer peripheral surface of a flange portion which is radially outwardly protruded and formed on the cam so as to engage with the side surface of the rope reel.

[Mode for Carrying Out the Invention]

[0010]

A preferred embodiment of the present invention will now be described with reference to the drawings. A recoil starter according to the embodiment of the present invention, as shown in Fig. 1, is constructed such that when a handle 3 which is joined to one end of a recoil rope 2 exposed outside a casing 1 is pulled, a rope reel 4 received within the casing 1 is rotationally driven and thus a cam 8 is rotated by the rope reel 4, so that a rotational member 9 coupled to a crankshaft of an

engine via a ratchet mechanism 10 which is engageable with cam pawls 11 formed on an outer peripheral surface of the cam 8, to thereby start the engine.

[0011]

As shown in Figs. 2 and 3, the rope reel 4 has the recoil rope 2 wound therearound, of which the one end is drawn outside the casing 1, and is rotatably supported by a support shaft 5 which is integrally formed on an inside of the casing 1 in a manner to be protruded inwardly in the casing 1. The other end of the recoil rope 2 wound around the rope reel 4 is fixed to the rope reel 4. The one end of the recoil rope 2 is drawn outside the casing 1 and has the handle 3 joined to the extremity thereof to manually pull the recoil rope 2. Pulling the handle 3 unwinds a wound portion of the recoil rope 2 from the rope reel 4 to rotate the rope reel 4 about the support shaft 5.

[0012]

A recoil spiral spring 6 is provided between a side surface of the rope reel 4 and an inner wall surface of the casing 1 so as to rotate the rope reel 4, which has been rotated by pulling of the recoil rope 2, in reverse, to thereby rewind the recoil rope 2 onto the rope reel 4. One end at an inner peripheral side of the recoil spiral spring 6 is fixed to the casing 1 while the other end at an outer peripheral side thereof is fixed to the rope reel 4. As the rope reel 4 is rotated by pulling the recoil rope 2, a rotational force is stored in the recoil spiral spring 6. When the recoil rope 2 is released, the rotational force stored in the recoil spiral spring 6 rotates the rope reel 4 in reverse, resulting in the recoil rope 2 being wound onto the rope reel 4.

[0013]

The cam 8 is mounted, adjacently to the rope reel 4, by a screw 22, to an end face of the reel shaft 5 formed on the casing 1 so as to be rotatable, so that the cam 8 transmits a rotation of the rope reel 4 to the crankshaft of the engine. A plurality

of the cam pawls 11 are formed on the outer periphery of the cam 8 so that the cam pawls 11 are disengageably engaged with the ratchet mechanism 10 provided on the rotational member 9 which is coupled to the crankshaft of the engine. When one of the cam pawls 11 is engaged with the ratchet mechanism 10 of the rotational member 9, a rotation of the cam 8 is transmitted to the crankshaft of the engine via the rotational member 9. In the illustrated embodiment, the ratchet mechanism 10 is constructed as a centrifugal clutch, so that due to a rotation of the rotational member 9 after startup of the engine, the ratchet mechanism 10 is rotationally moved in a direction of disengaging from the cam pawls 11 by a centrifugal force. As a result, transmission of rotation between the engine side and the cam 8 is interrupted.

[0014]

Annular recesses 12 and 13 are formed respectively on opposing side surfaces of the rope reel 4 and the cam 8 such that the annular recesses 12 and 13 are opposite to each other. The annular recesses 12 and 13 receive a damper spring 14 therein which rotationally couples the rope reel 4 and the cam 8. As shown in Fig. 4, the damper spring 14 is configured in the form of a torsion coil spring, and has an engaging portion 15 at one end thereof, which engaging portion is formed by bending one end portion of the damper spring 14 horizontally into a U shape. The engaging portion 15 is received within one of holding grooves 16 which are formed on the outside of the annular recess 12 of the rope reel 4 to be contiguous to the annular recess 12, with a result that the rope reel 4 and the damper spring 14 are rotationally coupled together. Another engaging portion 17, bent in an axial direction, is formed on the other end of the damper spring 14. The engaging portion 17 is inserted in a holding hole 18 which penetrates from a bottom 28 of the annular recess 13 to a top side of the cam 8, so that the other end of the damper spring 14 is rotationally coupled to the cam 8.

[0015]

The annular recesses 12 and 13 of the rope reel 4 and the cam 8 include respective inner peripheral surfaces which form bosses 19 and 20 having the same outer diameter. The damper spring 14 is disposed such that end faces of the bosses 19 and 20 are butted against each other substantially at the middle of the coiled portion of the damper spring 14 received within the annular recesses 12 and 13. Such construction allows the coiled portion of the damper spring 14 to wind and tighten substantially uniformly around outer peripheral surfaces of the respective bosses 19 and 20 of the rope reel 4 and the cam 8 when a predetermined rotational force is stored in the damper spring 14 by a startup resistance of the engine, with a result that a further elastic deformation of the damper spring 14 is inhibited and a maximum stress is limited.

[0016]

The engaging portion 15 of the damper spring 14 held by the rope reel 4 is received within the holding groove 16 and held such that the engaging portion 15 can move toward and away from the outer peripheral surface of the boss 19 of the annular recess 12 of the rope reel 4. The holding hole 18 formed at the bottom 28 of the annular recess 13 of the cam 8 is formed to be elongated in a radial direction of the cam 8. The engaging portion 17 at the other end of the damper spring 14 is loosely fitted into the holding hole 18 so as to allow the engaging portion 17 to approach the outer peripheral surface of the boss 20 of the cam 8. Such construction allows the overall length of the coiled portion of the damper spring 14 to uniformly wind and tighten around the bosses 19 and 20 as shown in Fig. 5 when the coiled portion of the damper spring 14 winds and tightens around the bosses 19 and 20. Such function is the same as that of a mechanism of a publicly known spring clutch. The coiled portion of the damper spring 14 functions as a spring clutch as the coiled portion winds and tightens around the bosses 19 and 20 of

the rope reel 4 and the cam 8, resulting in the bosses 19 and 20 being rotationally coupled together.

[0017]

As shown in Figs. 3 and 4, the cam 8 which forms the annular recess 13 is provided at one side thereof with a flange portion 23 which is radially outwardly extended and integrally formed thereon. The flange portion 23 of the cam 8 is provided at an outer peripheral side of the side surface thereof with an annular guide 24. The circular guide 24 is fitted within an annular recessed portion 25 which is formed on the side surface of the rope reel 4 so as to guide relative rotation between the cam 8 and the rope reel 4. The cam 8 and the rope reel 4 are incorporated into the casing 1 in the following manner. First, the rope reel 4 is mounted to the support shaft 5 formed on the casing 1. Then, the damper spring 14 is attached to the boss 19 of the rope reel 4 while the engaging portion 15 of one end of the damper spring 14 is fitted within the holding groove 16 of the rope reel 4. Thereafter, the cam 8 is placed on the side surface of the rope reel 4 such that the engaging portion 17 at the other end of the damper spring 14 is inserted into the holding hole 18 formed on the cam 8, and then the screw 22 is fastened to the distal end of the support shaft 5. The cam 8 is supported at its center by a proximal portion of the screw 22 so as to be rotatable with respect to the support shaft 5 and also supported at the outer peripheral side of the flange portion 23 by the annular recessed portion 25 of the rope reel 4 so as to be rotatable, so that inclination of the cam 8 due to an eccentric load acting on the cam 8 can be inhibited and breakage of the cam 8 due to the eccentric load can be prevented.

[0018]

Now, the operation of the recoil starter of the embodiment will be described. Prior to engine startup operations, the ratchet mechanism 10, provided on the rotational member 9 which is coupled to the crankshaft of the engine, is retracted due to

the action of a spring and is located at an inner side position where the ratchet mechanism 10 is to come into contact with the cam pawls 11 formed on the cam 8. When the recoil rope 2 is pulled to rotate the rope reel 4, the cam 8 is caused to rotate together with the rope reel 4 via the damper spring 14. The cam pawl 11 of the cam 8 is brought into contact with the ratchet mechanism 10, to thereby rotate the rotational member 9 via the ratchet mechanism 10 and also rotate the crankshaft of the engine coupled to the rotational member 9. At this time, although a rotational load of the cam 8 increases due to an increase in rotational load resulting from a startup resistance of the engine, the damper spring 14 is twisted to absorb the load, whereby a shock is prevented from being directly transmitted to the recoil rope 2.

[0019]

At this time, twisting of the damper spring 14 results in a rotational force of the rope reel 4 being stored in the damper spring 14. As the damper spring 14 is twisted, the diameter of the coiled portion thereof diminishes, so that the coiled portion thereof is caused to wind and tighten around the bosses 19 and 20 of the rope reel 4 and the cam 8, with the result that no more stress acts on the damper spring 14. Under this condition, the rope reel 4 and the cam 8 are coupled together as an integral part by the action of the damper spring 14 like a spring clutch, so that a rotation of the rope reel 4 is directly transmitted to the cam 8. At this time, since the engaging portions 15 and 17 at the opposite ends of the damper spring 14 are moved inwardly, substantially the overall length of the coiled portion of the damper spring 14 comes into a close contact with the outer peripheral surfaces of the bosses 19 and 20, with the result that the end portions of the damper spring 14 are not subjected to an excessive stress.

[0020]

At this time, an eccentric load acts on the cam 8 between the

cam pawl 11 engaged with the ratchet mechanism 10 and the holding hole 18 supporting the damper spring 14. However, the cam 8 is supported at its center by the screw 22 and supported at the outer peripheral side of the flange portion 23 of a large diameter by the side surface of the rope reel 4, thus inhibiting inclination and deformation of the cam 8 due to the eccentric load.

[0021]

Further, when the rotational force exceeds the startup resistance of the engine as the rope reel 4 is rotated, the rotational force of the rope reel 4 by pulling the recoil rope 2 and the rotational force stored in the damper spring 14 are released to the cam 8, so that the rotational force is transmitted to the rotational member 9 via the ratchet mechanism 10. As a result, the crankshaft of the engine is caused to be rotated abruptly, to thereby start the engine. When the engine starts and the crankshaft rotates, the ratchet mechanism 10 moves rotationally outwardly due to the action of centrifugal force, so that the ratchet mechanism 10 disengages from the cam pawl 11 of the cam 8. When the recoil rope 2 is loosened after startup of the engine, the rope reel 4 is rotated in the reverse direction by the rotational force stored in the recoil spiral spring 6, whereby the recoil rope 2 is wound onto the rope reel 4.

[0022]

[Effect of the Invention]

As described above, according to the invention, when an excessive load occurs on the engine side, the damper spring winds and tightens around the outer peripheral surfaces of the bosses formed on the rope reel and the cam, so that substantial deformation of the damper spring due to the excessive load is inhibited. Therefore, a decrease in durability of the damper spring due to the excessive load can be prevented. Moreover, according to the present invention, the coiled portion of the damper spring rotationally couples the rope reel and the cam

together as an integral part by gradually winding and tightening around the bosses, thus giving no feel of collision unlike the conventional stopper described above and providing an improved feel during engine startup operations performed by pulling the recoil rope.

[0023]

Further, since the engaging portions at the opposite ends of the damper spring are supported so as to move toward and away from the outer peripheral surfaces of the bosses, substantially the overall length of the coiled portion of the damper spring winds around the bosses and rotationally couples the rope reel and the cam as an integral part due to the action of the spring clutch. This maintains a stress which is generated at the engaging portions at the opposite ends of the damper spring low, thus extending the durability of the damper spring.

[0024]

In accordance with claim 2 of the invention, since the end faces of the bosses formed on the rope reel and the cam are butted substantially at the middle of the coiled portion of the damper spring, the coiled portion of the damper spring winds and tightens uniformly around the outer peripheral surfaces of both of the bosses with a predetermined number of turns or more, thus rotationally coupling the rope reel and the cam together due to the action of the spring clutch. Such construction permits a rotational force from the rope reel to be transmitted to the cam without any excessive stress taking place on the damper spring.

[0025]

In accordance with claim 3 of the invention, since the cam is supported at two points, one at the center and the other at the outer periphery, by the screw and the flange portion so as to be rotatable, the cam is more resistant to being inclined and displaced due to an eccentric load. As a result, in a case where only one of the two ratchet mechanisms engages with the cam pawl or in a case where there is provided only one ratchet mechanism,

inclination of the cam by a heavy eccentric load can be prevented, thus keeping the cam intact.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a front view illustrating a recoil starter according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a front view illustrating the recoil starter shown in Fig. 1 with a rotational member removed.

[Fig. 3]

Fig. 3 is a sectional side elevation view of the recoil starter shown in Fig. 1.

[Fig. 4]

Fig. 4 is a perspective view showing a rope reel, a damper spring and a cam used in the embodiment of Fig. 1.

[Fig. 5]

Fig. 5 is a sectional side elevation view of the recoil starter shown in Fig. 3 wherein the damper spring is tightly wound.

[Fig. 6]

Fig. 6 is a sectional side elevation view illustrating a conventional recoil starter.

[Fig. 7]

Fig. 7 is a sectional side elevation view illustrating the conventional recoil starter shown in Fig. 6 in a state where a damper spring is subjected to an excessive stress.

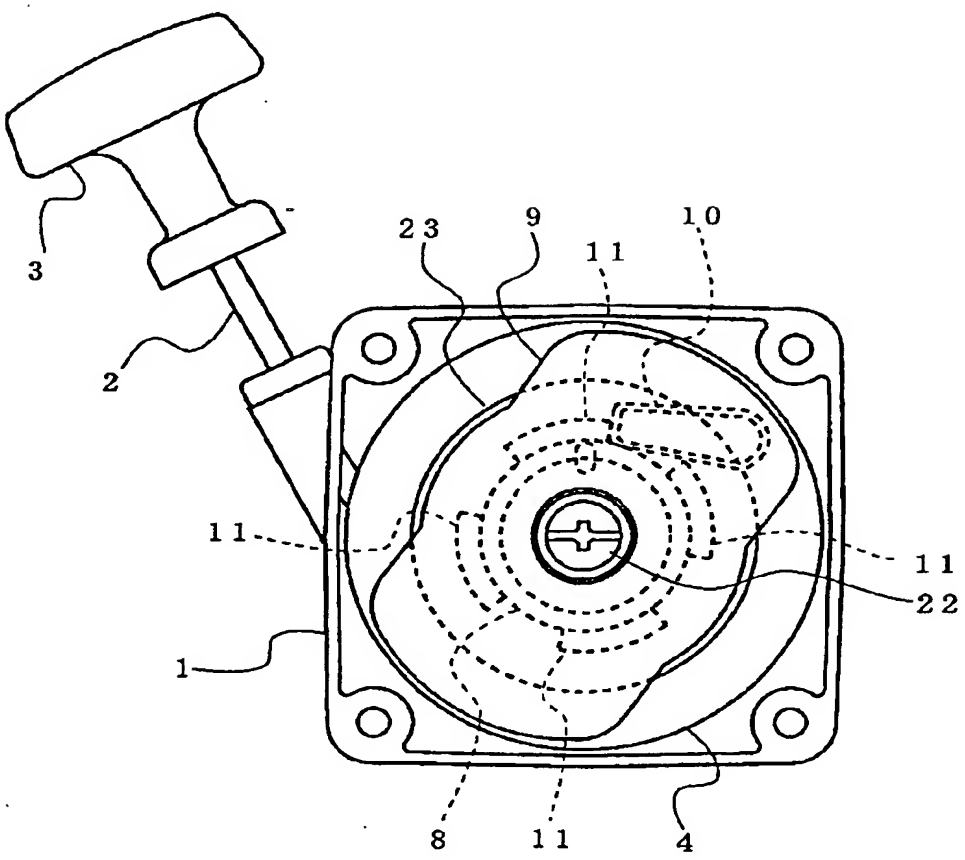
[Explanation of Reference Numerals]

1 Casing
4 Rope reel
5 Support shaft
8 Cam
9 Rotational member
10 Ratchet mechanism
11 Cam pawl

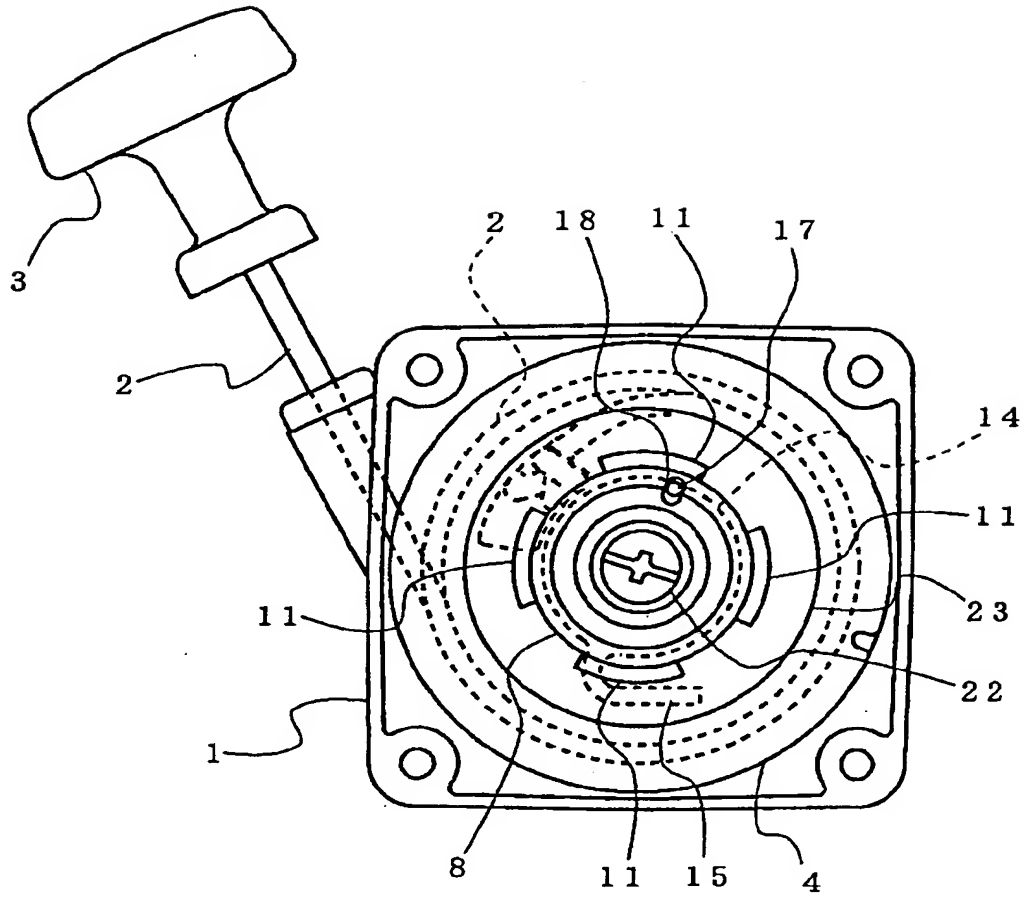
12 Annular recess
13 Annular recess
14 Damper spring
15 Engaging portion
16 Holding groove
17 Engaging portion
18 Holding hole
19 Boss
20 Boss
22 Screw
23 Flange portion
24 Annular guide
25 Annular recessed portion

[Title of Document] Drawings

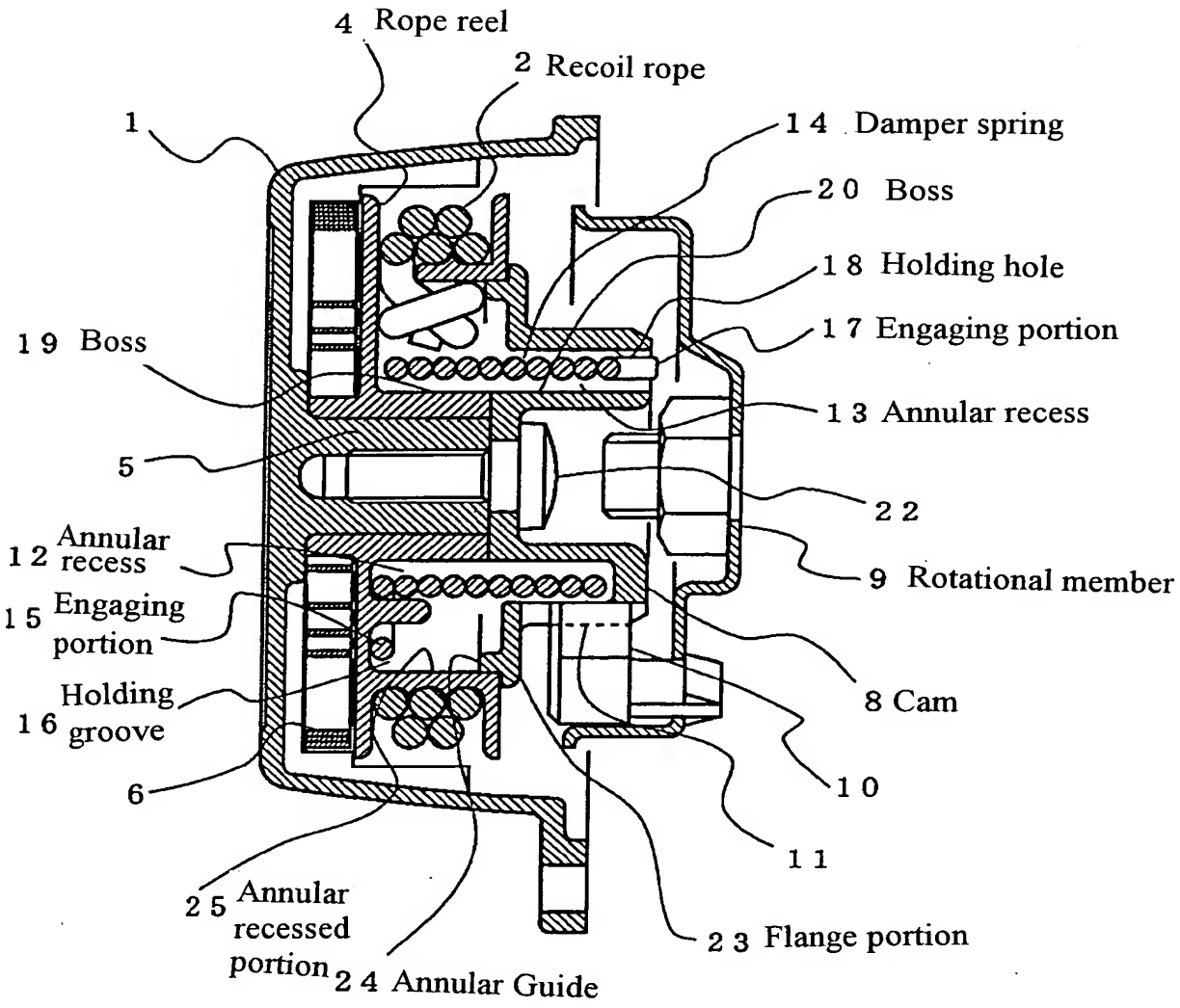
[Fig. 1]



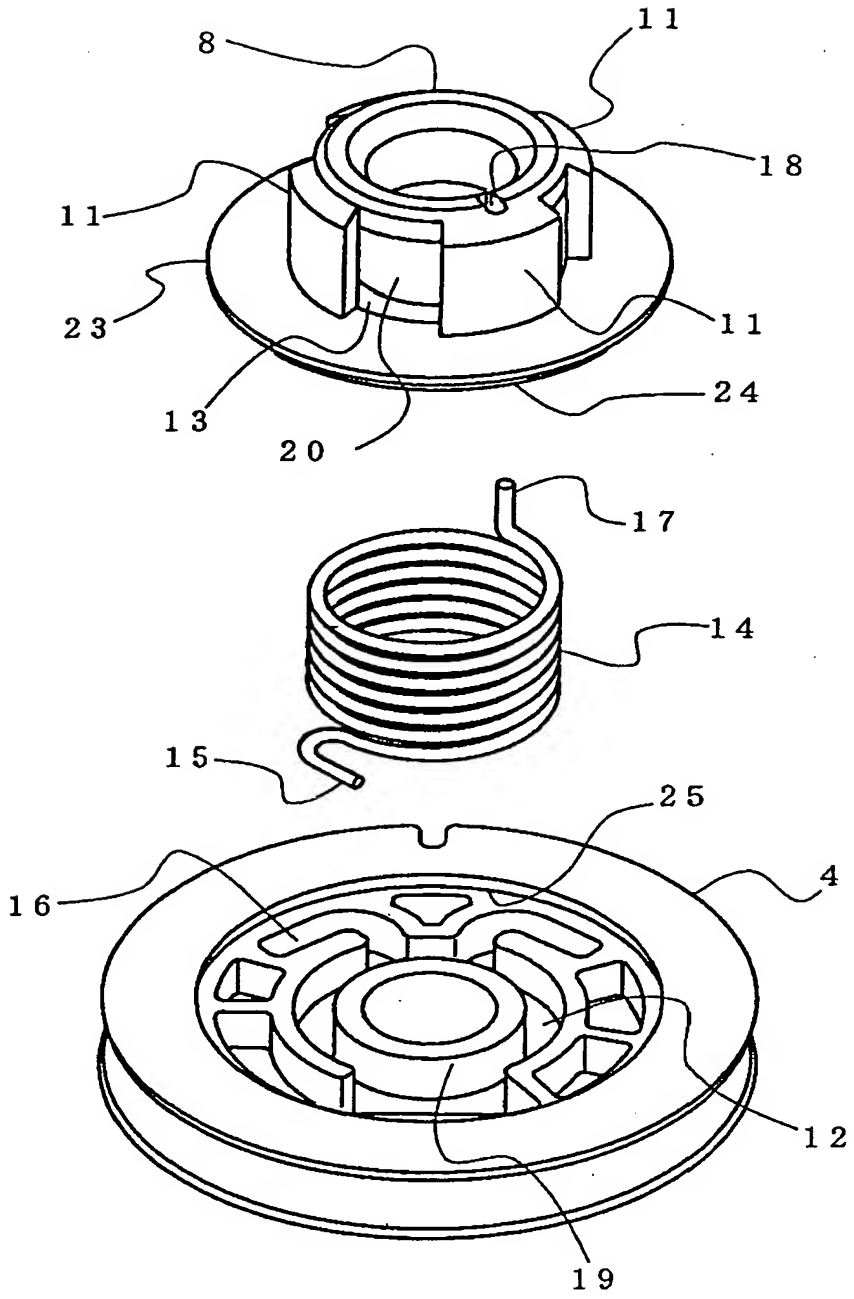
[Fig. 2]



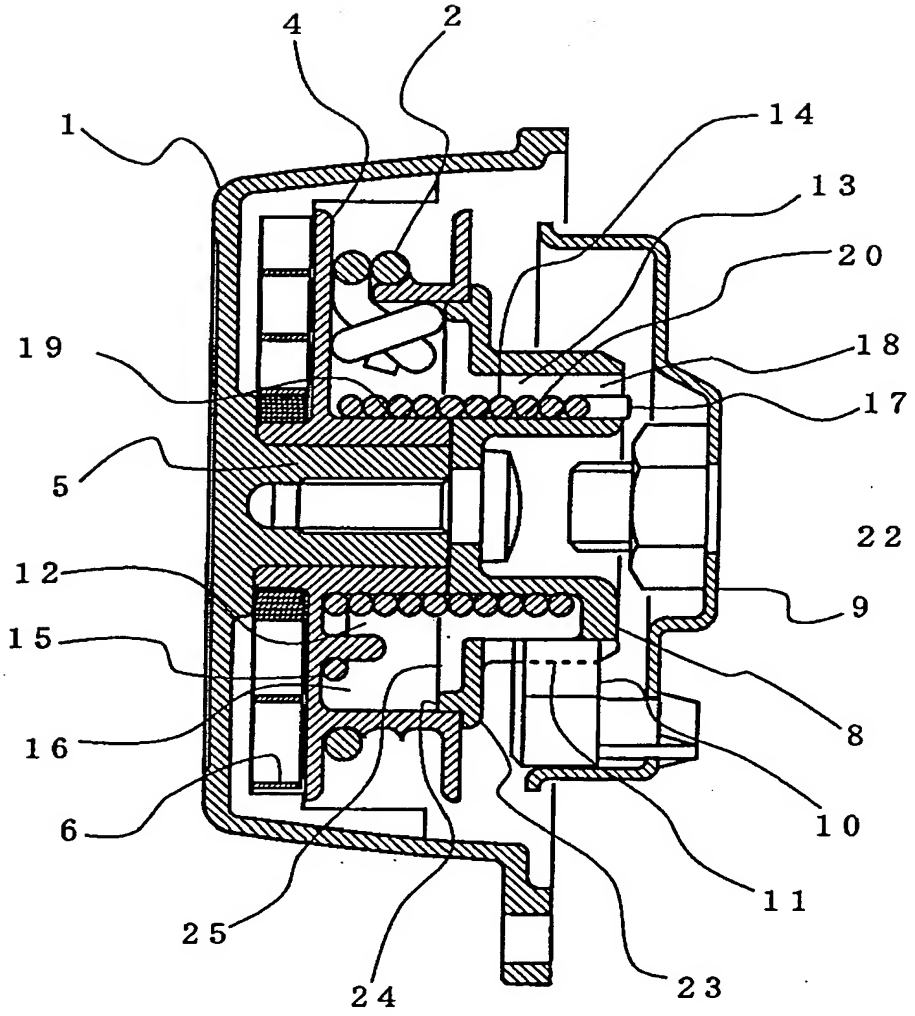
[Fig. 3]


4 Rope reel
2 Recoil rope
1
14 Damper spring
20 Boss
18 Holding hole
19 Boss
17 Engaging portion
13 Annular recess
5
22
12 Annular recess
9 Rotational member
15 Engaging portion
8 Cam
Holding 16 groove
10
6
11
25 Annular recessed portion
24 Annular Guide
23 Flange portion

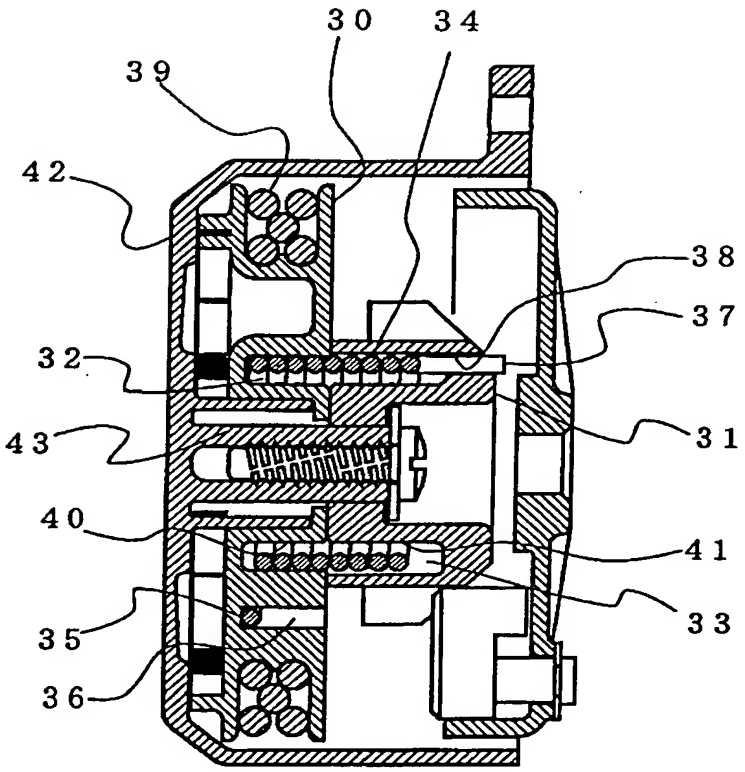
[Fig. 4]



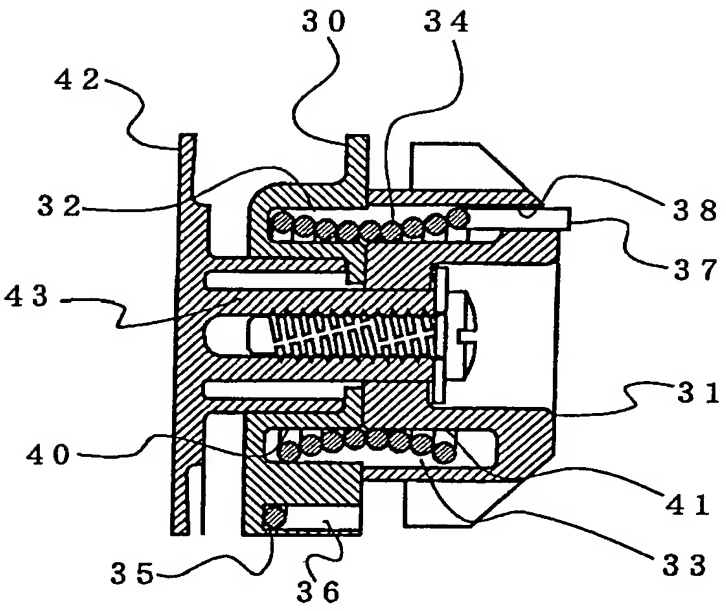
[Fig. 5]



[Fig. 6]



[Fig. 7]



[Title of Document] Abstract

[Abstract]

[Problem to be Solved] To enhance durability of a recoil starter by improving durability of a damper spring 14 and a cam 8 incorporated therein through inhibiting excessive deformation of the damper spring and an eccentric load on the cam.

[Means for Solving Problem] The recoil starter includes a damper spring 14 disposed around bosses 19 and 20 formed on a rope reel 4 and a cam 8 while the damper spring 14 has opposite ends thereof held on the rope reel 4 and the cam 8, respectively, so that a rotation of the rope reel 4 is transmitted to the cam 8 via a resilience of the damper spring 14. The damper spring 14 has, at the opposite ends thereof, engaging portions 15 and 17 radially movably supported by holding portions 16 and 18 of the rope reel 4 and the cam 8, respectively, so that substantially the overall length of the damper spring 14 winds and tightens uniformly around outer peripheral surfaces of both bosses 19 and 20 due to a startup resistance of the engine.

[Elected Figure] Fig. 3